C H A P T E R 2 0

Network Communications

This chapter presents PC 99 requirements and recommendations for network adapters and related technologies.

Contents

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Introduction to NDIS 5.0

The Network Driver Interface Specification (NDIS) 5.0 represents a number of extensions to the interface described in NDIS 3.0 and 4.0. The basic requirements, services, terminology, and architecture of the earlier versions also apply to NDIS 5.0. The new NDIS architecture will be included in Windows 98 and Windows NT 5.0 operating systems.

NDIS 5.0 consists of all functionality defined in NDIS 4.0, plus the following extensions:

- NDIS power management, required for network power management and network wake up.
- Plug and Play is now applicable to Windows NT 5.0 network drivers.
- Windows hardware instrumentation support for structured, cross-platform management of NDIS miniports and their associated adapters.
- Simplified network INF format across Windows operating systems, based on the Windows 95 INF format.
- Deserialized miniport for improved performance on Windows NT multi-processor systems.
- New mechanisms for for off-loading tasks such as TCP/IP checksum, IP Security, TCP message segmentation, and Fast Packet Forwarding to intelligent hardware.
- Broadcast media extension, required for broadcast components.
- Connection-oriented NDIS, required for native access to connection-oriented media such as ATM (including ATM/ADSL, ATM/cable modem, and so on.) and ISDN.
- Support for QoS when supported by the media.
- Intermediate driver support—which is required for broadcast components, virtual LANs, LAN emulation over new media (ATM, satellite or broadcast television, and so on), packet scheduling for QoS, and NDIS support over WDM-supported buses such as IEEE 1394 and Universal Serial Bus (USB).

NDIS Extensions for ATM and QoS. Previously, NDIS primarily supported network interface card driver development and deployment of connectionless network media such as Ethernet, Token Ring, ArcNet, and Fiber Distributed Data Interface (FDDI). NDIS 5.0 extends this interface to provide efficient support for connection-oriented media such as ATM (including ATM/ADSL, ATM/cable modem, and so on) and ISDN, with support for QoS and with isochronous data transfer for media that supports QoS. The new architecture also enables support for streaming of multimedia data such as audio and video over the NDIS media. Information about the miniport driver model is included in the Windows NT 5.0 DDK.

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Note: NDIS 5.0 features are accessible only by using the NDIS miniport driver model and are not supported for full MAC drivers.

System Requirements for Network Communications

This section summarizes the basic hardware design features for network communications devices and the specific features for PC 99.

Note: References to adapters, network interfaces and so on in this chapter should be taken to apply to add-on network adapter cards, network implementations on the system motherboard and external network interfaces equally and without preference for any of these types of implementation unless otherwise noted.

1. PC system includes network adapter

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Recommended	*Required*	*Recommended*

It is recognized that OEMs supply PC systems to corporations for networking purposes in situations where the customer will insert network adapters at the end-user site. If the device is present in the system, it must meet the minimum requirements for network adapters defined in this chapter. Office PC 99 systems submitted for testing must include either a network adapter or a modem.

2. PC system includes internal or external ISDN device

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Recommended (*)	*Recommended*	*Recommended (*)*

If an ISDN device is present in the system, it must meet the minimum requirements for ISDN devices defined in this chapter. For information about serial ISDN devices, see the “Modems” chapter in Part 4 of this guide.

Note: For items 2 through 6 marked with the (*) symbol, it is recommended to include either an ADSL modem, cable modem, ISDN device, or home networking adapter for Internet access in Consumer PC and Entertainment PC systems. For higher-speed multimedia networking, either an ADSL modem, cable modem or home networking adapter is recommended. The goal of these recommendations is to provide a high quality Internet connection thus improving the user experience.

3. PC system includes cable modem

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Recommended (*)	*Optional*	*Recommended (*)*

Cable modems are not required features for any PC 99 system. Recommendations are provided in this chapter for informational purposes only.

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4. PC system includes ATM adapter

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Optional	*Optional*	*Optional*

ATM adapters are not required features for any PC 99 system. If the device is present in the PC system, it must meet the minimum requirements for ATM adapters defined in this chapter.

5. PC system includes ADSL adapter

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Recommended (*)	*Optional*	*Recommended (*)*

ADSL devices are not required features for any PC 99 system. If the device is present in the PC system, it must meet the minimum requirements for ADSL adapters defined in this chapter.

6. PC system includes satellite or broadcast receiver with NDIS driver

Consumer PC 99	*Office PC 99*	*Entertainment PC 99*
Recommended	*Optional*	*Recommended*

For information about the PC 99 requirements for supporting a broadcast receiver, which requires NDIS 5.0 support, see the “Video and Broadcast Components” chapter in Part 4 of this guide.

Network Adapter Requirements

This section defines basic PC 99 hardware feature requirements for network adapters. Many of these requirements also apply to other network communications devices (such as, ISDN, cable modem, ADSL). They are specifically identified and listed in the beginning of each section as applying to a particular device category.

7. Adapter uses NDIS 5.0 miniport driver

Required

For PC 99, the network adapter driver must be written to NDIS 5.0 in order to take advantage of new operating system capabilities and must follow the NDIS miniport driver model defined in the Windows NT 5.0 DDK.

Note: The development of full MAC drivers is no longer supported. Support for full MAC drivers in the operating system will be removed in future versions of Windows.

If the network device is for connection-oriented media, such as ATM, ISDN, Frame Relay or X.25, it must have ~~an NDIS 5.0~~ connection-oriented miniport driver that follows the connection-oriented model defined ~~with call manager functionality as defined~~ for NDIS 5.0 in the Windows NT 5.0 DDK. Also, for the connection-oriented media, there needs to be an NDIS 5.0 call manager driver as defined in the DDK.

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In some cases, such as ATM, the call manager driver is included in the operating system. Consequently, all that a vendor needs to provide for an ATM adapter is an NDIS 5.0 connection-oriented miniport driver. For other connection-oriented media, such as ISDN or X.25, since the call manager is not included in the operating system, it needs to be provided with the hardware by the vendor.

The call manager support can be integrated into the connection-oriented miniport driver or implemented as a separate NDIS 5.0 call manager driver. The documentation of both options, integrated or separated call manager, is included in the Windows NT 5.0 DDK.

An intermediate NDIS 5.0 miniport driver is required for network adapters that connect to the PC using IEEE 1394 or USB buses. This driver exposes its media type to NDIS at its upper edge and interfaces with the appropriate bus driver (IEEE 1394 or USB) at its lower edge.

8. An intermediate NDIS 5.0 miniport driver is deserialized
Recommended

NDIS 5.0 introduces support for deserialized miniports. This enables performance improvements and scaleability on Windows NT multiprocessor systems.

In case of regular (serialized) miniports, NDIS simplifies the driver development by implementing the lock and queue management on behalf of the miniport driver. When these drivers are called, NDIS is always called first before the miniport driver is entered, which enables NDIS to maintain the lock states and manage the queues for regular miniport drivers. This is not always the case with intermediate miniport drivers, where the driver may be called directly by another driver outside NDIS, such as USB bus driver. Therefore, intermediate miniport drivers should be written as deserialized drivers implementing the lock and queue management in the driver.

9. Full-duplex adapter automatically detects and switches to full duplex mode
Required

If the network adapter supports full duplex and if the network switch that the adapter is connected to supports full duplex and standard ways of detecting the duplex mode, then the network adapter must be capable of automatically detecting the duplex mode and must use that mode by default. The goal is to automatically configure this setting without end-user intervention.

10. Adapter automatically senses presence of functional network connection
Required

The network adapter must be capable of dynamically determining whether it is functionally connected to a link partner such as a hub, switch, or router. The device must indicate the link state at boot time, after returning to D0 power state, whether if the link state changed while in a lower power state, and when the link state changes while in the D0 power state. No time limit is specified for the required detection or status indication.

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If the adapter is on an expansion card not used as a boot device, then the device drivers can determine the presence of the functional link. If it is not functionally connected to a link partner, the miniport driver must provide appropriate NDIS status indication, using support for cable sense in NDIS 5.0.

~~No time duration~~ limit ~~is specified for the required detection or status indication.~~

Note: this is a recommendation for 10Base-2 or AUI network adapters and a requirement for all others.

For information about NDIS status codes and indication mechanisms, see the Microsoft Windows NT 5.0 DDK.

11. Adapter automatically senses transceiver type
Required

Network adapters that support multiple transceivers must be capable of automatically detecting which transceiver type is connected to the network. The network adapter then must automatically use that transceiver. In all cases, the user must not be required to set jumpers or manually enter information to inform the operating system of the transceiver type.

~~Note: this is a recommendation for 10Base-2 or AUI network adapters and requirement for all others.~~

12. Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
Required

Recommended: Byte buffer alignment for all buffers, which imposes fewer limitations on overlying software components.

Buffer alignment refers to the allowed offset addresses (boundaries) where packets can begin. Memory allocated for receive buffers must be quadword-aligned or better (byte-aligned or word-aligned). The send buffer must be capable of handling byte-aligned buffers.

The network adapter must impose minimal buffer-alignment restrictions.

13. Adapter communicates with driver across any bridge
Required

If the adapter uses a bridge, all communications must be free of errors across any bridge, such as a PCI bridge adapter.

14. Adapter supports filtering for at least 64 multicast addresses~~, at minimum~~
Required

Recommended: 128 addresses.

This requirement applies to those networking technologies that support multicast, such as ethernet, and not to those which do not, such as token ring, which, for

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example, distributes IP multicast traffic using the functional address (as specified in RFC 1469.)

~~Note: This requirement applies only to Ethernet adapters as IP multicast traffic in Token-Ring environment will be distributed using the functional address (as specified in RFC 1469).~~

This capability is needed to support new push technology applications such as Microsoft NetShow, Active Desktop, and Internet Explorer 4.0. PC 99 requires a minimum capability for filtering 64 multicast addresses (also known as channels). This number is expected to increase incrementally in coming years. Future requirements will specify filtering for a minimum of 128 addresses.

15. The adapter and driver support promiscuous mode
Required

This ensures that the adapter can be used with Microsoft Network Monitor Agent. This requirement applies only to LAN (non-switched) media.

Notice that, by default, promiscuous mode is not turned on. ~~Configuring~~ Enabling promiscuous mode should be possible only by using the Microsoft Network Monitor Agent or another similar administrative application.

16. Adapter is compatible with remote new system setup capabilities if used as boot device
Required

For a PC 99 system that uses a network adapter to support installing the operating system, the network adapter must be compatible with remote new system setup capabilities as defined in the *Network PC System Design Guidelines*. ~~open industry-standard Dynamic Host Configuration Protocol (DHCP). The DHCP provides for dynamic configuration of PCs on TCP/IP networks, as specified in Internet Engineering Task Force (IETF) RFCs 1533, 1534, 1541, and 1542. Trivial File Transfer Protocol (TFTP), Revision 2, supports boot-image download, as specified in IETF RFC 1530.~~

For Office PC 99, a network adapter and system BIOS support are required to use the adapter as a boot device, as defined in the "BIOS meets PC 99 requirements for boot support" requirement in the "PC 99 Basic Guide" chapter in Part 2 of this guide.

~~The complete mechanism for remote new system setup is defined in the *Network PC System Design Guidelines.*~~

17. Device Bay-type network adapter meets PC 99 requirements
Required

Any networking communications device designed as a Device Bay peripheral must interface with either USB, IEEE 1394, or both, and must support relevant USB device class specifications. All Device Bay peripherals must meet the requirements defined in *Device Bay Interface Specification, Version 1.0*.

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18. PCI network adapters are bus masters
Required
To improve the system performance by offloading the processor load, PCI network adapters must be bus masters.

19. USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices
Recommended
For PC 99, it is recommended that USB network communications device vendors participate in the USB Device Working Group's effort to define networking extensions to the USB Class Definitions for Communications Devices, and that they implement their hardware to this specification when it is released.

Vendors are also encouraged to participate in the definition and implementation of similar IEEE 1394 efforts.

ISDN Requirements

This section summarizes the design features for ISDN devices.

In this section, "internal ISDN device" refers to the ISDN terminal adapter, which exposes raw access to its B channels using NDIS miniports. NDIS miniports could also be attached to the PC using WDM-supported bus classes such as USB or IEEE 1394 (thereby physically being an external device).

In this section, "ISDN modem" refers to an ISDN device that exposes itself as a modem controlled by the AT command set. To Windows operating systems, these devices look like modems, and the operating system can use these devices as modems, provided that the hardware manufacturer has done the work to ensure that these devices look and act like modems. This work includes the following:

- A modem INF file for installing the device and for telling Unimodem which commands to use to control the ISDN device.
- Interpretation of the standard modem AT command set.

  This can be done either in the ISDN device itself or in a serial port driver. For more information, please refer to the TIA-602 specification, a subset of ITU V.250.

This section defines general requirements for ISDN and specific requirements for ISDN terminal adapters. For more information about the requirements for ISDN modems, see the "Modems" chapter in Part 4 of this guide.

For PC 99, ISDN is recommended but not required for high-speed connections. If implemented in a PC 99 system, ISDN must meet the requirements defined in this chapter. For Plug and Play, power management, and driver support requirements, see the "PC 99 Design for Network Communications" section later in this chapter.

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20. Internal ISDN device meets PC 99 network adapter requirements
Required

For PC 99, the driver must be written to NDIS 5.0. Only NDIS 5.0 miniport drivers and INF files are allowed for complete user-friendly installation and operation of the ISDN adapter.

The following requirements must be met, as defined in the "System Requirements for Network Communications" section earlier in this chapter:

- Adapter uses NDIS 5.0 connection-oriented miniport driver, with call manager support
- Adapter automatically senses presence of functional network connection
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- Adapter communicates with driver across any bridge
- Device Bay-type network adapter meets PC 99 requirements
- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

21. Internal ISDN device supports synchronous HDLC framing
Required

High-level data link control (HDLC) framing is a standard for sending synchronous data. Other framing methods are allowed if the miniport driver provides simple HDLC framed synchronous PPP packets to NDIS.

22. NDIS interface and driver support raw unframed synchronous B channel I/O
Required

The internal ISDN device and the driver must support raw unframed (that is, non-HDLC) synchronous B channel I/O at 64 Kbps per B channel, with each B channel individually accessible. This will enable H.320 as well as voice calls over ISDN.

For these raw interfaces, the direct path to each B channel must support synchronous transmission and reception of H.221 frames, which are of 20 ms duration. To achieve this without additional latency to H.221, there must be support for overlapped I/O buffers at intervals of less than or equal to 20 ms in each direction. As underruns or overruns cause degraded audio, hardware buffering must be adequate to prevent B channel underruns and overruns. (For Windows 98 and Windows NT 5.0, 20 ms is adequate.).

This can be achieved by making buffering software configurable with adequate range to handle foreseeable real-world conditions. The miniport driver should make I/O completion callbacks to NDIS for each I/O buffer as soon as the I/O for that buffer is complete and should not coalesce or delay callbacks.

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23. ISDN driver supports unattended installation, with limitations
Required
Configuration of the dependent parameters, such as SPIDs and switch-type IDs, must be done through the ISDN Configuration wizard included in the operating system.

24. ISDN device with U-interface includes built-in NT-1
Recommended
Note: This recommendation applies only in the United States.

NT-1 (network terminator) splits the duplexed transmit and receive signals from the ISDN line into separate transmit and receive components. An ISDN device with a built-in NT-1 can connect directly to the ISDN line. However, doing so prevents other devices from being attached to the ISDN line. (Only one NT-1 can be connected to an ISDN line.)

This is why, if the ISDN device has built-in NT-1, it is also recommended that it has a connector for either analog phone or another ISDN device (S/T-interface), such as ISDN phone. Adding an analog (POTS) port or S/T-interface to the ISDN device delivers convenience to the SOHO market, allowing customers to use one ISDN line to meet all their telecommuting needs at minimal cost. Many customers in this market don't want a separate analog or digital phone line for their fax machines, modems, or phone when ISDN can do this with a device that has POTS port or S/T-interface.

25. ISDN device includes software-selectable terminating resistors
Required
If the ISDN device has an S/T-interface for connecting additional ISDN devices, it must also have software-configurable terminating resistors. The software-selectable resistors can be selected on or off. The default value of the termination is on in North America, but off in all other countries, where phone companies unconditionally provide the termination.

Cable Modem Requirements

Cable modems connected to a PC are one component in a system that cable-television operators use to deliver high-speed cable data services to customers. Cable modem provides two-way services: Data flows downstream from the cable operator's head end and upstream from the customer's PC. At the head end, the cable data system is terminated by the cable modem termination system (CMTS). The CMTS terminates the (upstream and downstream) RF, MAC layer and possibly Layer 3 protocols from the cable side. CMTS provides the internetwork connection between the cable system and the rest of the network at the headend. CMTS can be implemented on proprietary hardware platform or a PC platform running Windows NT to provide different networking functions such as routing, QoS support (such as RSVP), and so on.

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Some implementations transmit upstream using ~~t~~narrowband networks such as ISDN or analog modem~~ ~~, while increasing numbers of RF return modems (for example, two-way modems) are being deployed as cable companies upgrade their networks to be two-way capable. Two-way modems are preferred, because they are always connected, perform better, and do not tie up phone lines or require modem banks.

There are currently ~~two~~ three cable modem specifications for cable modems~~.~~ :

- Data-Over-Cable Service Interface Specification (DOCSIS) developed by the Multimedia Cable Network System (MCNS) consortium
- 802.14 developed by IEEE
- DVB/DAVIC (Digital Video Broadcasting/Digital Audio-Visual Council) developed by DAVIC and DVB and adopted by ETSI and ITU

Industry support for DOCSIS is growing rapidly in North America. In present form, its upper layers fully describe IP traffic encapsulated by 802.3/DIX Ethernet framing. (ATM is left for future study.)

External Ethernet ~~MCNS~~ DOCSIS cable modems provide IEEE 802.1d bridging for one or more Customer Premises Equipment (CPE); a PC attaches to them indirectly through its 10BASE-T network adapter. Integrated cable modems attach directly to the PC over buses such as USB, PCI, and IEEE 1394 and currently require the vendor to develop an associated NDIS 5.0 miniport driver for it. This miniport driver exposes an 802.3/DIX Ethernet adapter interface to the operating system, and it interfaces to the cable modem hardware using the appropriate bus (PCI) or bus interface driver (USB, IEEE 1394) at its bottom edge.

In contrast to DOCSIS, both the 802.14 and the DVB/DAVIC efforts are focused on the usage of Asynchronous Transfer Mode (ATM). Typical integrated 802.14 or DVB/DAVIC cable modems would implement an ATM adapter interface and be accompanied by an NDIS 5.0 ATM miniport driver.

26. Device is implemented as an integrated cable modem
Recommended

For PC 99, an integrated cable modem is recommended. This means integrating everything from the cable modem's physical interface layer (RF coax connector) up through a standard PC 802.3/DIX Ethernet or ATM adapter MAC interface onto a single device. In other words, the PC software perceives the integrated cable modem as a standard Ethernet or ATM network adapter.

An example of this is a USB-attached ~~MCNS~~ DOCSIS implementation that integrates cable modem Physical Media Dependent (PMD), downstream convergence, cable MAC, link security, 802.3/DIX MAC "adapter" filtering, and USB device interface functions in the same box. Similar devices can be implemented that are attached using PCI or IEEE 1394 buses.

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27. Integrated cable modem meets PC 99 network adapter requirements
Required

For the integrated cable modem, the following requirements must be met as defined in the "Network Adapter Requirements" section earlier in this chapter:

- Adapter uses NDIS 5.0 miniport driver
- Adapter automatically senses presence of functional network connection
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- Adapter communicates with driver across any bridge
- Adapter supports filtering for at least 64 multicast addresses~~, at minimum~~
- Device Bay-type network adapter meets PC 99 requirements
- PCI network adapters are bus masters
- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

28. An integrated cable modem should expose an ATM or Ethernet interface to the operating system ~~Implement to MCNS DOCSIS or 802.14 cable modem specifications~~
Required

~~PC 99-compliant cable modems must be implemented to either the MCNS DOCSIS specifications or the IEEE 802.14 specification (when published). Currently the MCNS DOCSIS specifications only describe the transfer of 802.3/DIX framed packets, so an integrated cable modem should expose an Ethernet network adapter interface to the operating system.~~

An ~~IEEE 802.14~~integrated cable modem should expose an ATM or Ethernet interface to the operating system. Refer to ATM Adapter requirements for ATM-specific requirements if an ATM/cable modem solution is implemented.

ATM Adapter Requirements

This section summarizes requirements for ATM hardware.

The NDIS 5.0 extensions provide kernel-mode NDIS 5.0 client drivers with direct access to connection-oriented media such as ATM. The new architecture for Windows and Windows NT extends native ATM support to Windows Sockets 2.0 (WinSock), TAPI, and DirectShow-based applications by providing system-level components that map the applicable WinSock, TAPI, and DirectShow APIs to NDIS 5.0, extending direct ATM access to user-mode applications.

If ATM is included in a PC 99 system or is specifically designed for Windows or Windows NT, it must meet the requirements outlined in this chapter. For basic requirements for Plug and Play, power management, and driver support, see the "PC 99 Design for Network Communications" section later in this chapter. For

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more details about the following requirements, please refer to ~~Section 3,~~ "ATM Layer Specification," in *ATM User-Network Interface Specification, Version 3.1*. (Also, note that the specification mentioned above includes references to other relevant specifications).

29. ATM adapter meets PC 99 network adapter requirements
Required

The following requirements must be met as defined in the "Network Adapter Requirements" section earlier in this chapter:

- Adapter uses NDIS 5.0 connection-oriented miniport driver
- Adapter automatically senses presence of functional network connection
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- Adapter communicates with a driver across any bridge
- Device Bay-type network adapter meets PC 99 requirements
- PCI network adapters are bus masters
- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

30. ATM adapter supports a minimum number of ~~active~~ simultaneous connections
Required

The VPI (Virtual Path Identifier) and VCI (Virtual Channel Identifier) ranges supported by the adapter affect the maximum number of simultaneous connections supported on a system.

This affects the applicability of the adapter to ATM applications such as LAN emulation, where at least one dedicated VC is created between each pair of communicating ATM hosts.

System type	Simultaneous connections
Client (ATM adapter)	64 or more
Client (Integrated ATM/ADSL- adapter)	32 or more
Server	2048 or more

A sample driver is provided in the Windows NT DDK to guide developers in properly supporting resources to meet this requirement.

31. ATM adapter supports all service types defined by the ATM Forum
Recommended

The ATM adapter should support the constant bit rate (CBR), variable bit rate (VBR), available bit rate (ABR), and unspecified bit rate (UBR) service types as defined by the ATM Forum.

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32. ATM adapter supports UBR service type

Required

UBR is used by default for standard ATM services such as LAN Emulation and IP over ATM. In addition, PPP is a widely used model for residential network access and UBR is used by default for PPP over ATM virtual circuits. Therefore, it is required for ATM adapters to support the UBR service type.

33. ATM adapter supports a minimum number of simultaneously active VBR/CBR connections

Required

Support for at least two simultaneously active VBR/CBR connections is required for basic ATM signaling and management. The two simultaneous active connections can be any combination of VBR and/or CBR.

Support for additional VBR/CBR connections is needed for ATM adapters that support multimedia or other traffic that demands QoS. These are listed in the following table.

System type	Simultaneous active VBR/CBR connections
Client	6
Server	500

34. ATM adapter supports traffic shaping

Required

The ATM adapter must support and enforce all the traffic-shaping rules specified for each service type it supports, including CBR, VBR, ABR, and UBR.

This includes enforcement of peak cell rate on UBR virtual circuits as described in the following requirement.

35. ATM adapter enforces PCR on UBR virtual circuits

Required

ATM adapters will be used to connect router, remote access, and content servers to the public ATM network. High-speed residential broadband access networks such as ADSL and cable modem will enable direct connection (via ATM virtual circuit) from home or small office computers to these servers.

When the Windows Dial-Up Networking UI is used to connect from the home or small business computer to the remote router or server, a PPP link is established over an ATM virtual circuit. The service type used on this PPP over ATM virtual circuit is UBR. When creating the UBR virtual circuit, Windows will request upstream and downstream line rates, or Peak Cell Rates (PCR), equal to the upstream and downstream line rates provisioned for the user. Windows uses ATM ILMI protocol to obtain information—including the user provisioned line rates, from the public network.

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To avoid packet loss and ensure efficient network utilization, it is critical that all ATM or integrated ATM/ADSL or ATM/cable modem adapters enforce requested PCR on UBR virtual circuits.

Since *any* ATM adapter might be installed in a server to which clients connect through the public network, this requirement applies to *all* ATM adapters.

36. ATM adapter and NDIS 5.0 miniport driver support dynamic link speed configuration

Required

When connected to a residential broadband network, ATM adapters must restrict the aggregate transmission rate across all active virtual circuits so that is does not exceed the provisioned upstream bandwidth of the residential broadband network.

Consequently, it is required that all integrated ATM/ADSL and ATM/CABLE Modem adapters support aggregate shaping of upstream bandwidth per the provisioned upstream bandwidth. In addition, since any 25M ATM adapter might be used to connect—via external ADSL modem, to an ADSL network, it is required that all 25M ATM adapters support this as well. This support is optional for ATM adapters with line rates higher than 25 Mbps.

The Windows ATM Call Manager uses ILMI to query the public network to find out what the provisioned maximum line rates for incoming and outgoing traffic are. The Call Manager then uses the *OID_GEN_CO_LINK_SPEED* NDIS request (in SET mode) to set the line rate for both incoming and outgoing traffic within which the adapter shall shape the aggregate of all ATM traffic.

37. ATM adapter supports external clocking

Required

Recommended: ATM adapter supports both internal and external (default) clocking.

Usually adapters can derive their transmit clocks from the switch's SONET frames (external clocking). Internal clocking is useful for diagnostics (connect Tx to Rx, and so on).

38. ATM adapter supports OAM

Recommended

Operation and maintenance (OAM) is needed for diagnostics.

This capability is recommended for Client systems, but is required for a Server system (layers F1–F5).

39. ATM adapter supports buffer chaining (Tx + Rx)

Recommended

This feature is needed for large packets.

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This capability is recommended for Client systems, but is required for a Server system.

ADSL Requirements

This section summarizes requirements for ASDL hardware.

New support is provided in the Windows and Windows NT operating systems for ADSL adapters and external ADSL modems (such as those using USB), which provide a faster method for moving data over regular phone lines.

It is recommended that manufacturers participate in developing standards for this technology. It is also recommended that manufacturers review the white paper, *An Interoperable End-to-End Broadband Service Architecture over ADSL System, Version 3.0* ~~or later~~, which discusses end-to-end service interoperability over ATM over ADSL. This paper, which is available from the web site at http://www.microsoft.com/hwdev/devdes/publicnet.htm, was jointly developed by over 30 leading ADSL vendors. The core idea of this white paper (PPP over ATM over ADSL) has been adopted by the ADSL Forum.

40. Device is implemented as an integrated ADSL modem
Recommended

For PC 99, it is recommended to have an integrated ADSL modem. This means the integration of the ADSL modem and higher layer transmission and media access functions on a single network device. A typical implementation is an integration of ADSL modem and an ATM interface on a single PCI network adapter. Another example is a similar device that connects to the PC using the USB or IEEE 1394 buses.

If you provide external ADSL modems (other than IEEE 1394 or USB), it is recommended to have an ATM interface for the ADSL modem to PC connection. In addition, an Ethernet interface can be included.

41. Integrated ADSL modem meets PC 99 network adapter requirements
Required

For the integrated ADSL modem, the following requirements must be met as defined in the “Network Adapter Requirements” section earlier in this chapter:

- Adapter uses NDIS 5.0 miniport driver
- Adapter automatically senses presence of functional network connection
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- Adapter communicates with driver across any bridge
- Device Bay-type network adapter meets PC 99 requirements
- PCI network adapters are bus masters

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- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

42. ATM/ADSL solution is implemented for integrated ADSL modems
Recommended

It is recommended that an integrated ADSL modem exposes ATM to the operating system. For ATM-specific requirements when an ATM/ADSL solution is implemented, see the requirements in the "ATM Adapter Requirements" section earlier in this chapter. This should comply with PPP over ATM architecture discussed earlier.

Note: Currently there are both ATM/ADSL-based and Ethernet/ADSL-based implementations to provide full-rate ADSL services in the market. For the Universal ADSL-based services to be rolled out for the residential markets within the next couple of years, the PPP/ATM/ADSL implementation referred to in this section is the implementation required in order for it to work.

43. ADSL modem supports DMT line encoding
Recommended

For PC 99, the ADSL modem must support DMT line encoding, which is recognized as industry standard for ADSL by ANSI as the T1.413 Issue 2 specification, and also by the Universal ADSL Working Group (see http://www.uawg.org). ~~, which consisted of leading PC vendors, network operators and ADSL vendors. The UAWG-based Universal ADSL modem supports splitterless operation, which is to avoid truck rolls to accelerate mass deployment.~~ The UAWG has adopted DMT specified by T1.413, with modifications being made to work in a splitterless environment.

44. ADSL modem supports ~~RA-ADSL~~rate adaptiveness
Recommended

On a rate adaptive digital subscriber line (RA-ADSL), the downstream and upstream data rates are independently set either by an automatic adaptive algorithm or by manual selection.

RA-ADSL provides the capability to optimize the transmission speed and performance over a range of telephone-line loop distances. Adaptive channel equalization ensures more robust performance in the presence of channel impairments and narrow-band interference.

This also helps telephone companies to provision RA-ADSL access on their existing networks. RA-ADSL products can be provisioned on many telephone lines without costly and time-consuming network upgrades.

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IrDA Requirements for Network Communications

The interface between Infrared Data Association (IrDA) hardware (framers) and the Windows IrDA stack is through NDIS 5.0 miniport drivers that adhere to the conventions described in *Infrared Extensions to the NDIS Version 4.0 Functional Specification*. The Windows IrDA stack expects that the hardware and NDIS drivers deal with framing, transparency, and error detection and also support media sense and speed change commands. Miniport drivers are responsible for discarding incoming frames with bad cyclic redundancy checks. These frames must never be forwarded to the protocol.

~~Laptop vendors or vendors bundling IrDA adapters for desktop computers cannot depend on IrDA chip-set vendors to supply drivers and INF files that will work with their hardware. IrDA hardware will be detected for Plug and Play on Windows 98 and Windows NT 5.0. The lack of driver or INF support or an install failure caused by improper Plug and Play ID will be very visible and problematic to the end user.~~

~~IrDA Plug and Play hardware must report a unique Plug and Play ID that correctly describes the chip set and transceiver combination. Unfortunately, there are no existing standards for Fast Infrared (FIR) Plug and Play IDs. It would be useful for an organization like IrDA, or the chip-set and transceiver vendors themselves, to publish known combinations of hardware and suitable FIR Plug and Play IDs.~~

Although the IrDA protocol stack in Windows NT 5.0 is different from the one on Windows 98, the Windows NT 5.0 DDK should be used for driver development for both platforms.

Note that the Windows NT 5.0 IrDA protocol stack imposes stricter requirements on drivers than the protocol stack on Windows 98.

45. Infrared device meets PC 99 network adapter requirements
Required

The following requirements must be met as defined in the “Network Adapter Requirements” section earlier in this chapter:

- Adapter uses NDIS 5.0 miniport driver
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- Adapter communicates with driver across any bridge
- Device Bay-type network adapter meets PC 99 requirements
- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

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46. Infrared device supports both FIR and SIR
Required
All infrared devices must comply with approved IrDA specifications, including support for SIR and FIR data devices.

47. IrDA hardware reports a unique Plug and Play ID ~~for each combination of the system-specific parameters~~sufficient to satisfy the PC 99 requirements for unattended driver installation
Required
FIR Plug and Play hardware must report a unique Plug and Play ID that matches the combination of the chip set, transceiver, and any other system-specific parameters, in order for the operating system to find and install the correct INF and the associated driver for the IrDA hardware.

In the best case, the IrDA hardware has only one Plug and Play ID, associated INF file, and a miniport driver that can autodetect the transceiver type and other system-specific parameters. This enables the installation and configuration of the hardware and the driver without any user intervention.

In other cases, for example, where the ~~chip set~~ miniport driver cannot autodetect the transceiver type, or any other system specific parameters, a unique Plug and Play ID for each combination of the chip set and the transceiver type must be reported. Also, an associated driver and INF file describing the configuration parameters must be provided by the vendor for each combination.

Home Networking Requirements

Home networking is a significant new area, with new requirements and different constraints than ~~office~~ conventional networking. Home networking is so new that as this is written, there is very little in the way of products on the market. In the short term, the most important applications are sharing Internet access and peripherals, but ~~it is possible that~~ new applications ~~will~~ may develop.

Because of the newness of this networking area, it is appropriate that this ~~specification~~ guide set a standard for the quality of the user experience while setting as few hard technical standards as possible to allow the field time to develop in the market place.

As described in the “PC 99 Basic Requirements” chapter in Part 2 of this guide, as well as in the “System Requirements for Network Communications” section earlier in this chapter, a modem or other Internet access device is required for Consumer PC 99. However, in a home of networked PCs, a gateway of some kind is desirable to provide multiple simultaneous access to the Internet from multiple clients in the home network.

The gateway between the home network and the Internet can be implemented in PC software or embedded in a non-PC networking device, such as WebTV

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running Windows CE. These gateway functions can include DHCP, Proxy, NAT, Router, Firewall, and so on. All the PCs in this scenario must have a network adapter for peer-to-peer connectivity and to be able to access the Internet link provided by the home gateway.

Although there is no explicit speed requirement for the home networking media, higher bandwidth supports greater capabilities. For example, to support MPEG-2 1.5 Mbps is needed.

48. Home networking adapters meet PC 99 network adapter requirements
Required

Note to Reviewers: The authors invite industry feedback on the feasibility of meeting these requirements for home networking adapters.

The following requirements must be met as defined in the "Network Adapter Requirements" section earlier in this chapter:

- Adapter uses NDIS 5.0 miniport driver
- Adapter automatically senses presence of functional network connection
- Adapter automatically senses transceiver type
- Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
- The adapter and driver support promiscuous mode for network media that confine network traffic signals within a single home
- Adapter supports filtering for at least 64 multicast addresses
- Adapter communicates with driver across any bridge
- Device Bay-type network adapter meets PC 99 requirements
- PCI network adapters are bus masters if the data rate is 20 Mbps or higher
- USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices

Home networks will differ from traditional, homogeneous business networks in that they are expected to incorporate many different types of media and link layer protocols spanning a relatively smaller number of hosts. While media types and link layer protocols will be optimized with respect to features such as bandwidth and isochrony, it is important that IP protocols be supported in every case in order to enable traditional PC-to-PC networking.

The following features are recommended:

- The adapter and driver support promiscuous mode for all network media.
- PCI network adapters are bus masters for any network data rate.

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49. Home networking uses appropriate media
Recommended

For new construction or remodeling, wiring or fiber cable capable of at least 100 Mbps over a distance of at least 100 meters~~(that is, 100BaseT on CAT5 wiring)~~, is recommended (for example, 100BaseT on CAT5 wiring).

Networking media solutions that do not require new wiring are also needed. Alternatives for these "no new wires" technologies include:

- New use for existing in-home power wiring.
- New use for existing in-home phone wiring.
- New use for existing in-home coax (cable TV) wiring.
- Wireless

All home networking implementations should be compliant with FCC regulations or, generally, with regional regulatory requirements for use within residential environments.

50. Any home networking media must support Internet Protocol (IP)
Required

Any home networking media must support Internet Protocol (IP), but will not preclude the use of other protocols.

~~The following requirements apply to these new media:~~

~~The media must support at least 1 Mbps data rate.~~

~~The media must support Internet Protocol (IP), but will not preclude the use of other protocols.~~

PC 99 Design for Network Communications

This section summarizes requirements related to the PC 99 design initiatives defined in Part 1 of this guide.

Plug and Play and Bus Design for Network Communications

The items in this section are PC 99 requirements for Plug and Play capabilities.

51. Each device has a unique Plug and Play device ID
Required

For a system-board device, there must be a Plug and Play device-specific ID.

Each bus-specific device must provide Plug and Play device IDs in the manner required for the bus it uses, as defined in Part 3 of this guide. For example, a PCI device must comply with PCI 2.1 requirements and also must provide a

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Subsystem ID and Subsystem Vendor ID as defined in the “PCI” chapter in Part 3 of this guide.

52. Automatic resource assignment and dynamic disable capabilities are supported

Required

The system must be capable of automatically assigning, disabling, and relocating the resources used by this device as necessary using the method required for the related bus class. When an end user changes this device or adds it to the system, setting resource assignments must not require changing jumpers or switches on either the adapter or the system board. In the event of an irreconcilable conflict with other devices on the system, the system must be able to disable the device to prevent the system from stalling.

53. Plug and Play capabilities support multiple adapters

Required

For network communications devices, the Plug and Play IDs and resource support must be sufficient to automatically support the addition of multiple network communications devices to the system. This is true both for the same and different types of network communications devices.

54. All resource settings are reported in the user interface

Required

All resource settings must be viewable in Device Manager and in adapter properties dialog boxes. All resource settings that can be changed by the user must be changed using the standard Windows user interface, not by way of INI files or other setting files.

This implies that all device resources must be set and read through the standard interfaces provided by the bus on which the device resides. For PCI devices, this interface is the PCI configuration space. Further, device parameter settings must be stored in the registry.

Power Management for Network Communications

This section summarizes the specific power management requirements for network communications devices.

55. Device complies with device class power management reference specification

Required

The *Network Device Class Power Management Reference Specification, Version 1.0a*, provides definitions of the OnNow device power states (D0–D3) for network adapters. The specification also covers device functionality expected in each power state and the possible wake-up event definitions for the class.

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Network communications devices that directly attach to the PC over power manageable buses (that is, USB, PCI, and IEEE 1394) must comply with this specification.

~~PCI-based network adapters must support the generation of a power management event (PME# assertion) from the D3 cold device state. PCI-based network adapters also must support network packet filtering capabilities as defined in the *Network Device Class Power Management Reference Specification, Version 1.0*.~~

56. Device supports wake-up events

Required

This requirement applies specifically to the following network communications devices and their associated NDIS 5.0 miniport drivers:

- Ethernet and Token Ring network adapters
- Integrated ~~MCNS~~/DOCSIS cable modems
- Other or future devices that transfer 802.3/DIX Ethernet framed packets

The *Network Device Class Power Management Reference Specification* does not yet define wake-up mechanisms for ISDN adapters or any network communications adapter that uses ATM signaling.

The system must be capable of being awakened from a lower power state based on network events specified by the local networking software. This capability yields the result that any standard Windows network access—such as connections to shared drives and WinSock connections, as well as focused service and management applications—has the capability to ~~wake~~ ~~awaken~~wake up machines ~~in~~ from lower power states.

~~For PC 99, support is required for peer-to-peer networking, personal web servers, and other transparent networking applications.~~ The *Network Device Class Power Management Reference Specification* defines three different wake-up events:

1. Detection of a change in the network link state,
2. Receipt of a network wake-up frame, or
3. Receipt of a Magic Packet.

For PC 99, to enable the systems to wake-up transparently in typical networking scenarios (such as peer-to-peer networking, personal web servers, and other networking applications), the network adapters and their associated NDIS 5.0 miniport drivers must support wake-up on receipt of a network wake-up frame (#2 above). Support for wake-up on detection of a change in the network link state (#1 above), or on receipt of a Magic Packet (#3 above) is optional.

~~Wake-up capabilities must be based on pattern matching, which is a method of filtering, in addition to the normal address filtering that occurs when the system is~~

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~~fully on.~~The packet patterns that define the wake-up frames are provided to the NDIS 5.0 miniport driver by the operating system. To enable Wake-On-LAN capability for basic networking scenarios, the network interface card must be capable of storing information describing a minimum of three wake-up packet patterns, and must be able to recognize wake up packets based on pattern matches anywhere in the first 128 bytes of the packet. It is recommended that the network adapters are capable of storing information describing at least five wake-up packet patterns to enable more advanced applications such as Wake-On-LAN capability on multi-homed systems or on receipt of multicast packets, in addition to the above basic scenarios.

PCI-based network adapters must support the generation of a power management event (PME# assertion) from the D3 cold device state if the physical layer technology is generally capable of operating under the voltage and current constraints of the D3 cold device state.

Note that only valid packets can be wake-up packets (for example, filtered packets must pass all normal received-packet checks). For example, RUNTS, short packets, fragments, and so on, should not be considered as potential wake-up packets.

Implementation details are described in the "Network Wake-up Frames" and "Network Wake-up Frame Details" sections of *Network Device Class Power Management Reference Specification, Version 1.0a* and in the Windows NT 5.0 DDK.

Device Drivers and Installation for Network Communications

This section summarizes requirements for network communications device drivers, in addition to the requirements for using an NDIS 5.0 miniport driver as defined in the "System Requirements for Network Communications" section earlier in this chapter.

57. Device drivers and installation meet PC 99 requirements
Required

The manufacturer does not need to supply a driver if a PC 99-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, the requirements for the device drivers and installation are defined in the "PC 99 Basic Requirements" chapter in Part 2 of this guide. The basic requirements include driver support for unattended installation and Help file support if special driver parameters are used.

For exceptions to unattended installation requirements for ISDN adapters, see the "ISDN Requirements" section earlier in this chapter.

For information about NDIS status codes and indication mechanisms, see the Microsoft Windows NT 5.0 DDK.

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58. Driver works correctly with Microsoft network clients and protocols
Required

This includes the 32-bit Microsoft client and NetWare-compatible clients provided with Windows, whether connected to a Windows NT-based server, a Novell NetWare 3.*x* or 4.*x* server, or a Windows-based peer server. In all cases, this includes connections using Microsoft TCP/IP, IPX/SPX-compatible protocol, and NetBEUI in local area networks and TCP/IP in wide area networks.~~.~~

59. NDIS miniport driver ~~does not make operating system–specific kernel calls~~makes only NDIS library calls or WDM system calls
Required

A miniport driver ~~that follows the NDIS 5.0 specification must not make operating system–specific calls. A correct driver~~must make~~s~~ calls only to the NDIS library or the WDM system. ~~The NDIS library provides all the functions a driver needs or should use.~~ This results in binary compatibility of the driver between Windows 98 and Windows NT 5.0.

~~The only acceptable exception would be an intermediate NDIS 5.0 miniport driver for the network devices that connect to the PC using IEEE 1394 or USB bus. This driver exposes its media type to NDIS at its upper edge and makes calls to the appropriate bus driver (IEEE 1394 or USB) at its lower edge.~~

NDIS conformance must be validated over a single network connection and multiple connections. For Windows NT, this must be validated on a multiprocessor system as part of PC 99 testing.

60. NDIS 5.0 driver uses new INF format
Required

For NDIS 5.0 drivers (which are required for Windows NT 5.0), all network components must use the new-style INF format, which is based on the Windows 95 INF format. For information, see the Windows NT 5.0 DDK.

Note: For Windows NT 5.0, there will be no legacy INF support and no satisfactory upgrade option for OEM components created for Windows NT 4.0.

Network Communications References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

1997 Version of National ISDN Basic Rate Interface Terminal Equipment Generic Guidelines, Document Number SR-3888
Phone: (800) 521-2673 (North America)
(908) 699-5800 (Outside North America)
http://www.bellcore.com

An Interoperable End-to-End Broadband Service Architecture over ADSL System
http://www.microsoft.com/hwdev/devdes/publicnet.htm

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ATM: The New Paradigm for Internet, Intranet & Residential Broadband Services and Applications, T. Kwok
Prentice Hall, 1998, ISBN 0-13-107244-7

ATM User-Network Interface Specification, Version 3.1
Prentice Hall, 1995
ISBN 0-13-393828-X
http://www.atmforum.com

Device Bay Interface Specification, Version 1.0
http://www.device-bay.org

DVB/DAVIC (Digital Video Broadcasting/Digital Audio-Visual Council)
http://www.dvb.org
http://www.davic.org

ETSI (European Telecommunication Standards Institute)
http://www.etsi.fr

ITU (International Telecommunication Union)
http:www.itu,ch

IEEE 802.14 Cable TV Working Group
http://www.walkingdog.com/

MCNS *Data-Over-Cable Service Interface Specifications*
http://www.cablemodem.com/

NDIS and Windows networking white papers
http://www.microsoft.com/ntserver/communications/

Network Device Class Power Management Reference Specification, Version 1.0a
http://www.microsoft.com/hwdev/onnow.htm

Network PC System Design Guidelines, Version 1.0b
http//www.microsoft.com/hwdev/netpc.htm

USB specifications
Phone: (503) 264-0590
Fax: (503) 693-7975
http://www.usb.org

Windows 98 DDK and Windows NT 5.0 DDKs
MSDN Professional membership

Checklist for Network Communications

If a recommended feature is implemented, it must meet the PC 99 requirements for that feature as defined in this document.

Consumer PC 99	Office PC 99	Entertainment PC 99
1. PC system includes network adapter		
Recommended	*Required*	*Recommended*

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2. PC system includes internal or external ISDN device

Recommended (*)	*Recommended*	*Recommended (*)*

3. PC system includes cable modem

Recommended (*)	*Optional*	*Recommended (*)*

4. PC system includes ATM adapter

Optional	*Optional*	*Optional*

5. PC system includes ADSL adapter

Recommended (*)	*Optional*	*Recommended (*)*

6. PC system includes satellite or broadcast receiver with NDIS driver

Recommended	*Optional*	*Recommended*

7. Adapter uses NDIS 5.0 miniport driver
Required

8. An intermediate NDIS 5.0 miniport driver is deserialized
Recommended

9. Full-duplex adapter automatically detects and switches to full duplex mode
Required

10. Adapter automatically senses presence of functional network connection
Required

11. Adapter automatically senses transceiver type
Required

12. Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send
Required

13. Adapter communicates with driver across any bridge
Required

14. Adapter supports filtering for at least 64 multicast addresses
Required

15. The adapter and driver support promiscuous mode
Required

16. Adapter is compatible with remote new system setup capabilities if used as boot device
Required

17. Device Bay-type network adapter meets PC 99 requirements
Required

18. PCI network adapters are bus masters
Required

19. USB-based or IEEE 1394-based device implements USB and IEEE 1394 device specifications for network communications devices
Recommended

20. Internal ISDN device meets PC 99 network adapter requirements
Required

21. Internal ISDN device supports synchronous HDLC framing
Required

22. NDIS interface and driver support raw unframed synchronous B channel I/O
Required

23. ISDN driver supports unattended installation, with limitations
Required

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24. ISDN device with U-interface includes built-in NT-1
Recommended

25. ISDN device includes software-selectable terminating resistors
Required

26. Device is implemented as an integrated cable modem
Recommended

27. Integrated cable modem meets PC 99 network adapter requirements
Required

28. An integrated cable modem should expose an ATM or Ethernet interface to the operating system
Required

29. ATM adapter meets PC 99 network adapter requirements
Required

30. ATM adapter supports a minimum number of simultaneous connections
Required

31. ATM adapter supports all service types defined by the ATM Forum
Recommended

32. ATM adapter supports UBR service type
Required

33. ATM adapter supports a minimum number of simultaneously active VBR/CBR connections
Required

34. ATM adapter supports traffic shaping
Required

35. ATM adapter enforces PCR on UBR virtual circuits
Required

36. ATM adapter and NDIS 5.0 miniport driver support dynamic link speed configuration
Required

37. ATM adapter supports external clocking
Required

38. ATM adapter supports OAM
Recommended

39. ATM adapter supports buffer chaining (Tx + Rx)
Recommended

40. Device is implemented as an integrated ADSL modem
Recommended

41. Integrated ADSL modem meets PC 99 network adapter requirements
Required

42. ATM/ADSL solution is implemented for integrated ADSL modems
Recommended

43. ADSL modem supports DMT line encoding
Recommended

44. ADSL modem supports rate adaptiveness
Recommended

45. Infrared device meets PC 99 network adapter requirements
Required

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46. Infrared device supports both FIR and SIR
Required

47. IrDA hardware reports a unique Plug and Play ID sufficient to satisfy the PC 99 requirements for unattended driver installation
Required

48. Home networking adapters meet PC 99 network adapter requirements
Required

49. Home networking uses appropriate media
Recommended

50. Any home networking media must support Internet Protocol (IP)
Required

51. Each device has a unique Plug and Play device ID
Required

52. Automatic resource assignment and dynamic disable capabilities are supported
Required

53. Plug and Play capabilities support multiple adapters
Required

54. All resource settings are reported in the user interface
Required

55. Device complies with device class power management reference specification
Required

56. Device supports wake-up events
Required

57. Device drivers and installation meet PC 99 requirements
Required

58. Driver works correctly with Microsoft network clients and protocols
Required

59. NDIS miniport driver makes only NDIS library calls or WDM system calls
Required

60. NDIS 5.0 driver uses new INF format
Required

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